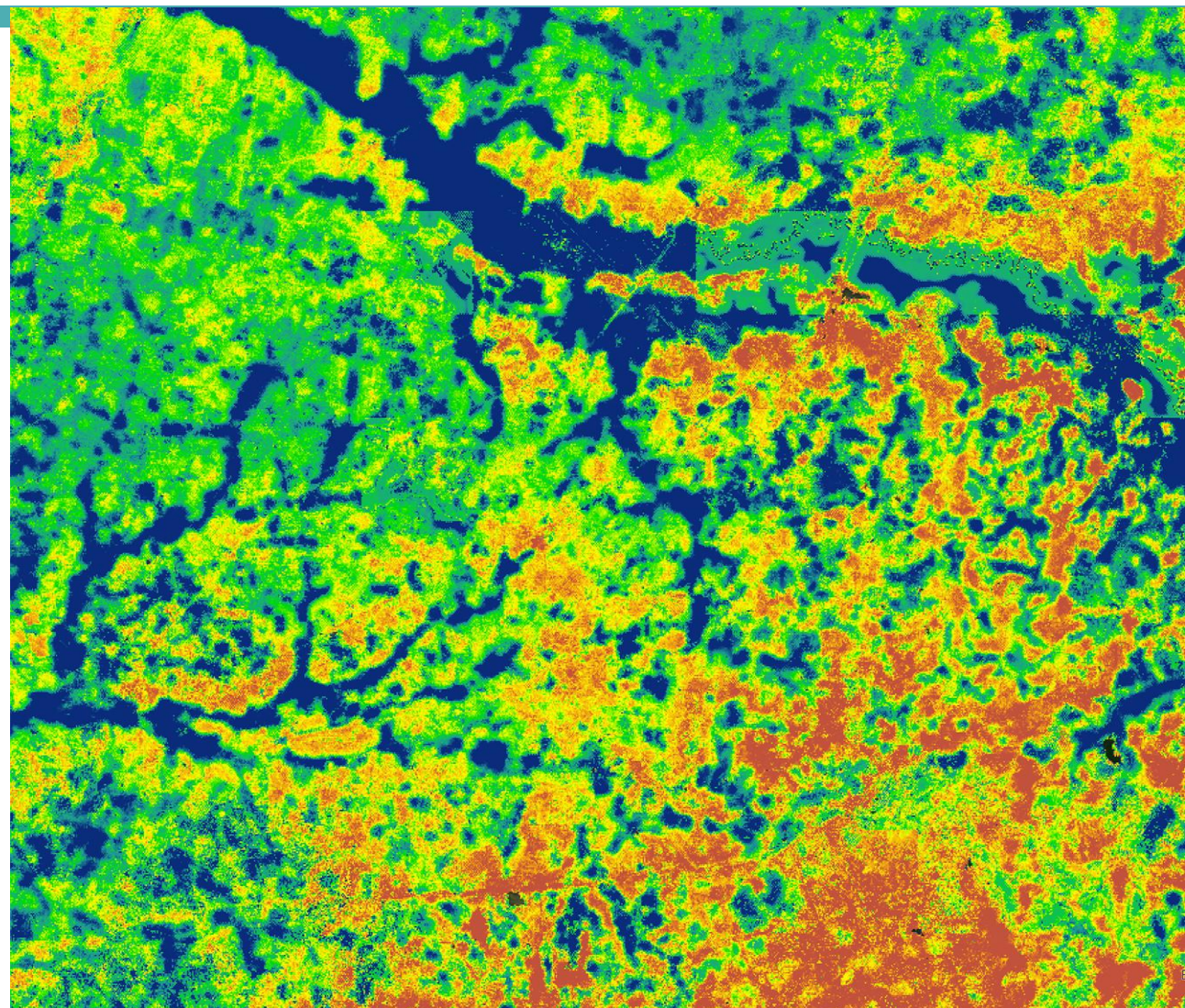




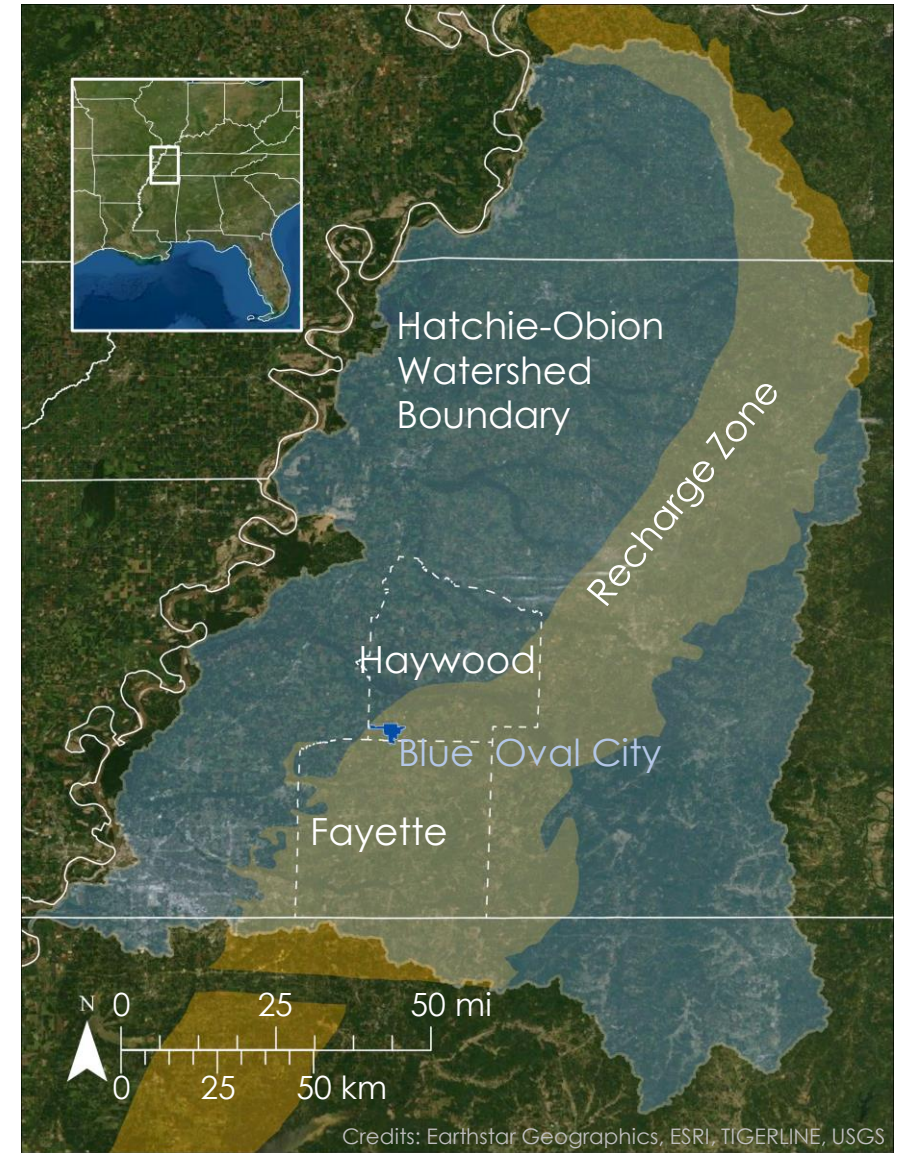
# Leveraging High Resolution Remotely Sensed Evapotranspiration Data to Assess Water Availability and Vulnerability in the Memphis Aquifer Area in West Tennessee

Lauren Webster\*, Katera Lee, Michael Pazmino, Elena Pilch,  
& Kathleen Lange





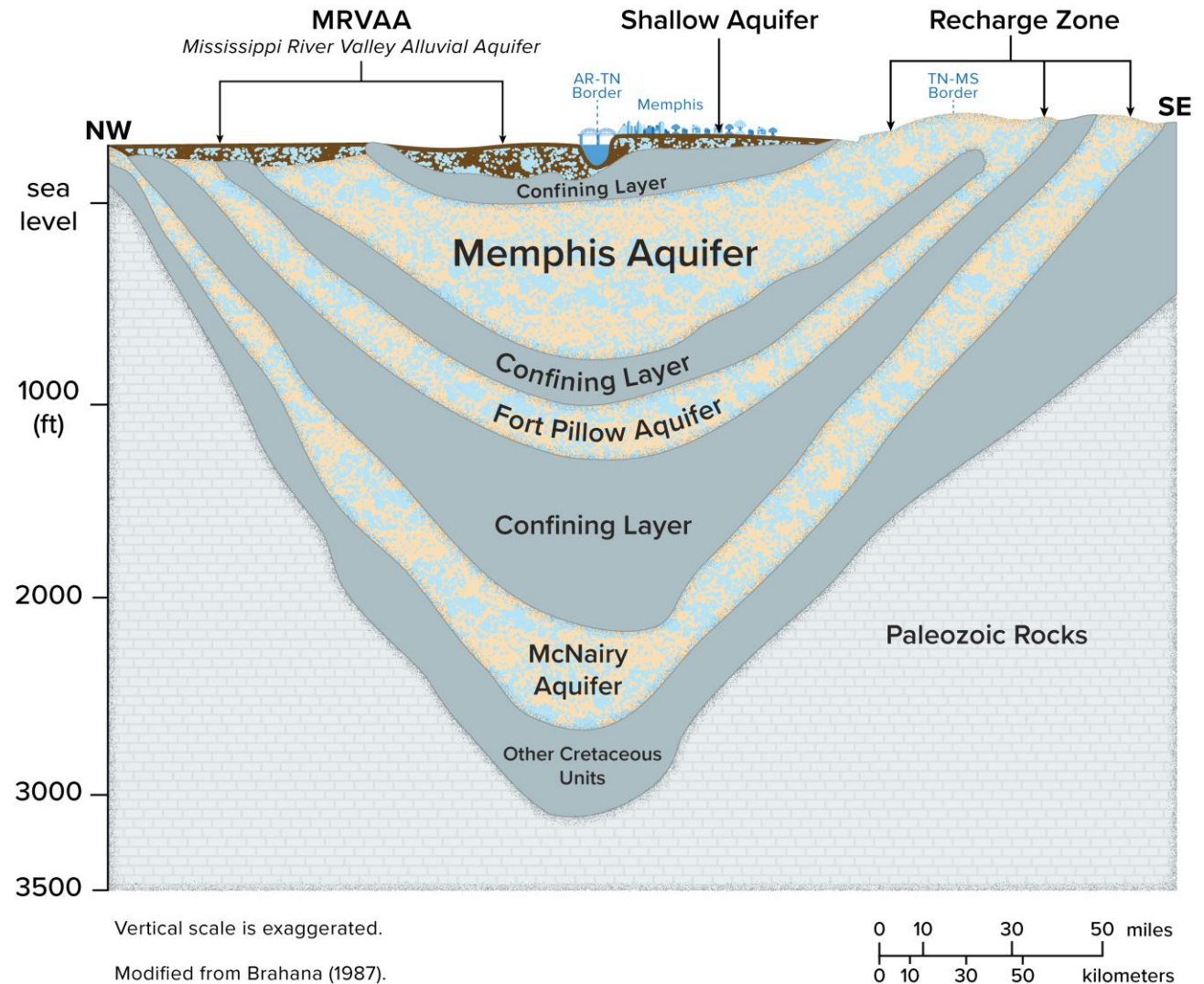
# The Memphis Aquifer



# About the Aquifer



- ▶ The pristine 2,000 - 3,000 year old water is protected from contamination by confining clay layers
- ▶ The recharge zone is the only area where precipitation can directly replenish the aquifer
- ▶ Supplies water to nearly a million residents



# Project Partners

**Protect Our Aquifer**



End User

**University of Memphis: Center  
for Applied Earth Science and  
Engineering Research**



Collaborator



# Objectives



**Map and quantify** seasonal evapotranspiration, evaporative stress, precipitation, and runoff to examine temporal variability



**Calculate seasonal water balance** using evapotranspiration and precipitation to create water balance maps

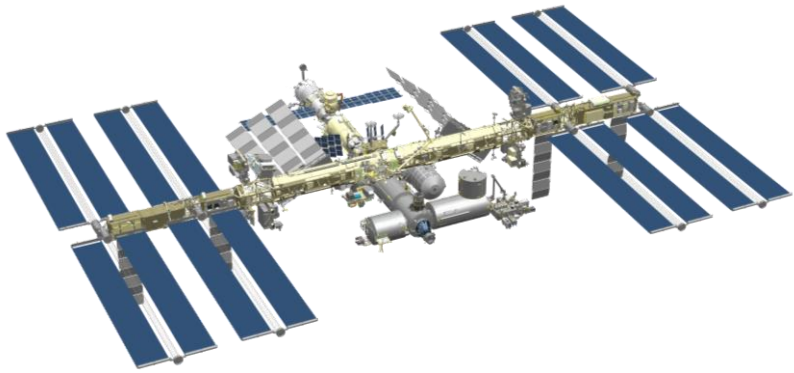


**Identify thriving areas** using evapotranspiration, water balance, runoff and landcover change





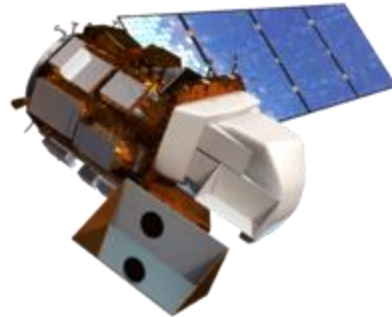
# NASA Earth Observation Platforms and Sensors



*International Space  
Station – ECOSTRESS*

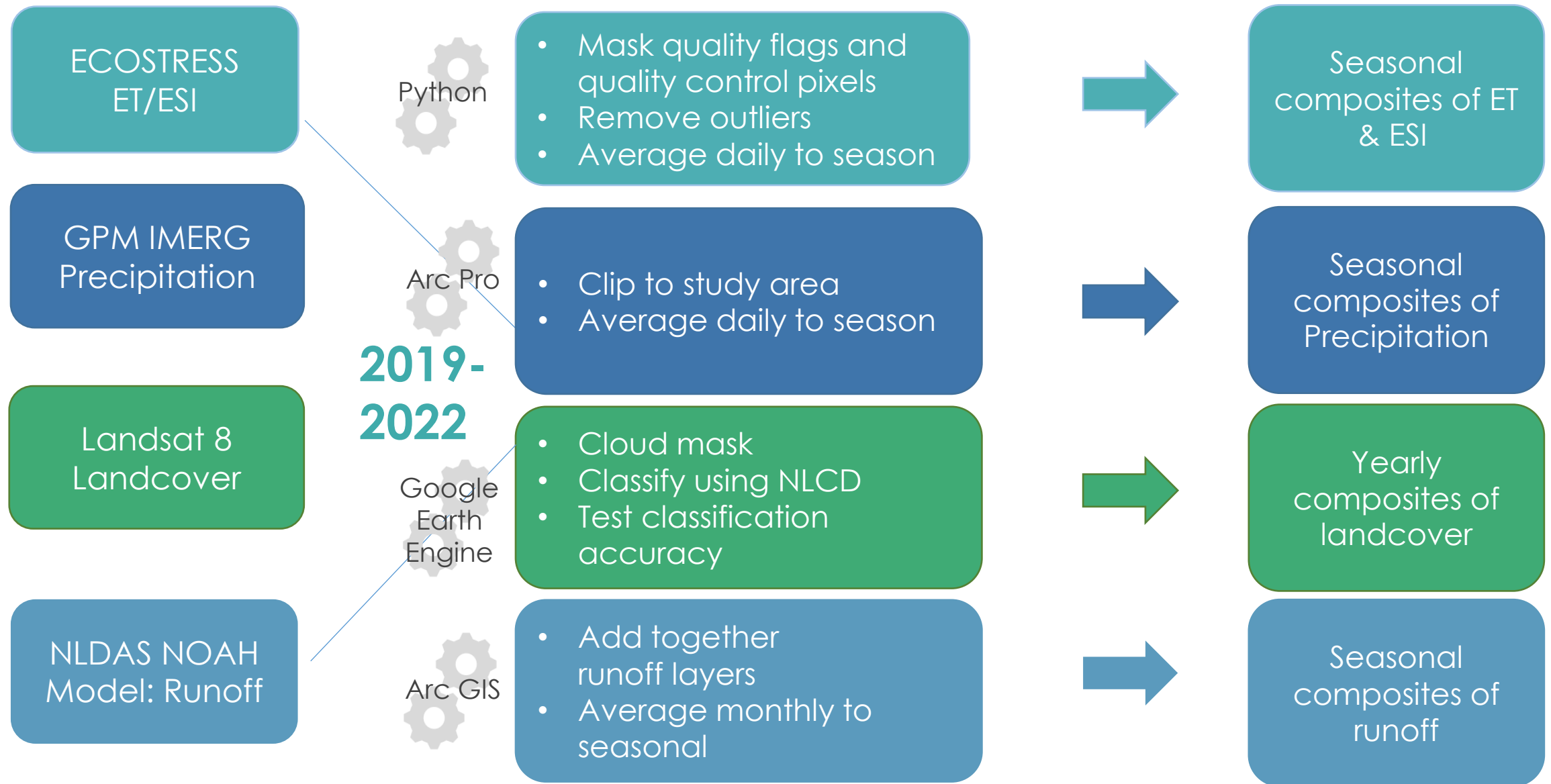


*GPM IMERG*



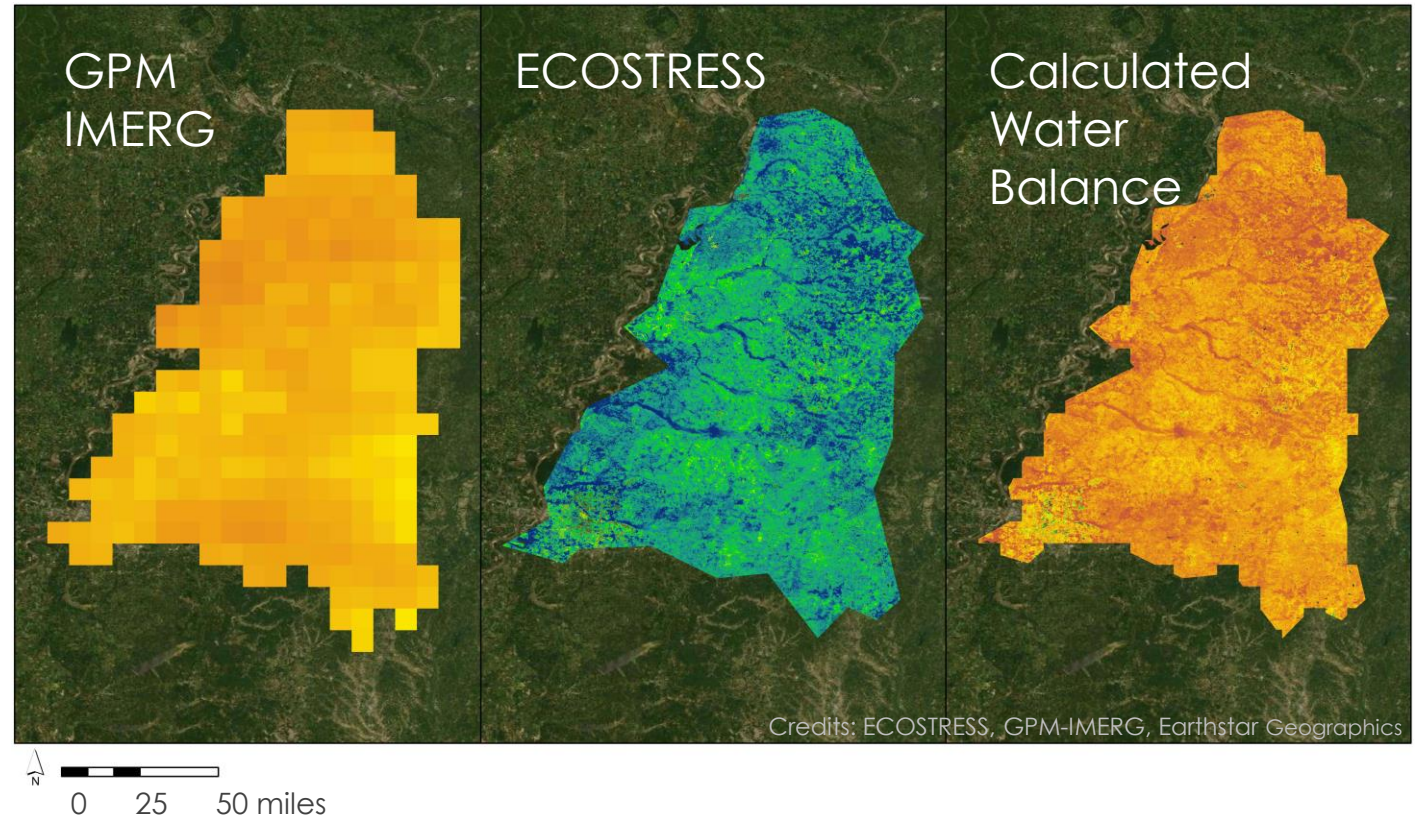
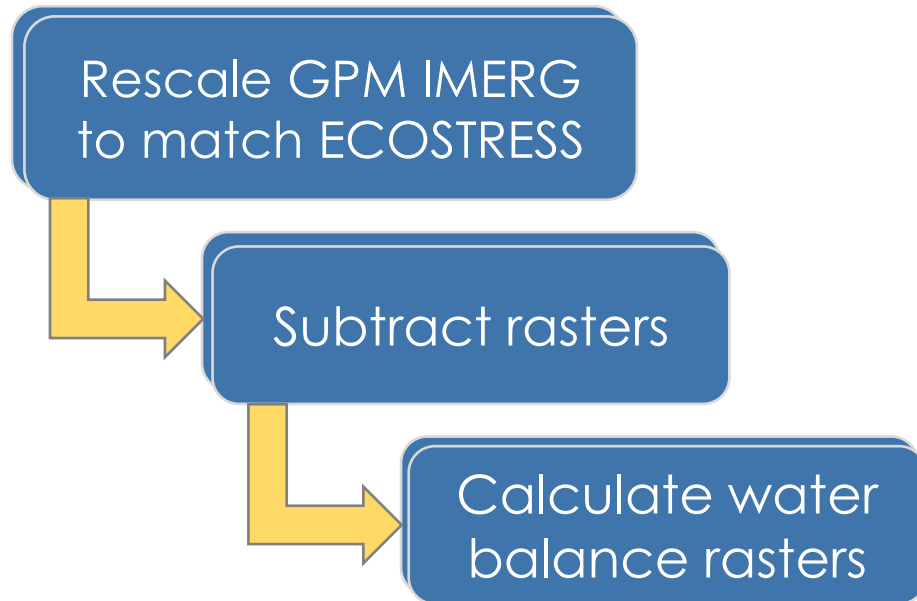
*Landsat 8 OLI & TIRS*

# Overview of Methodology



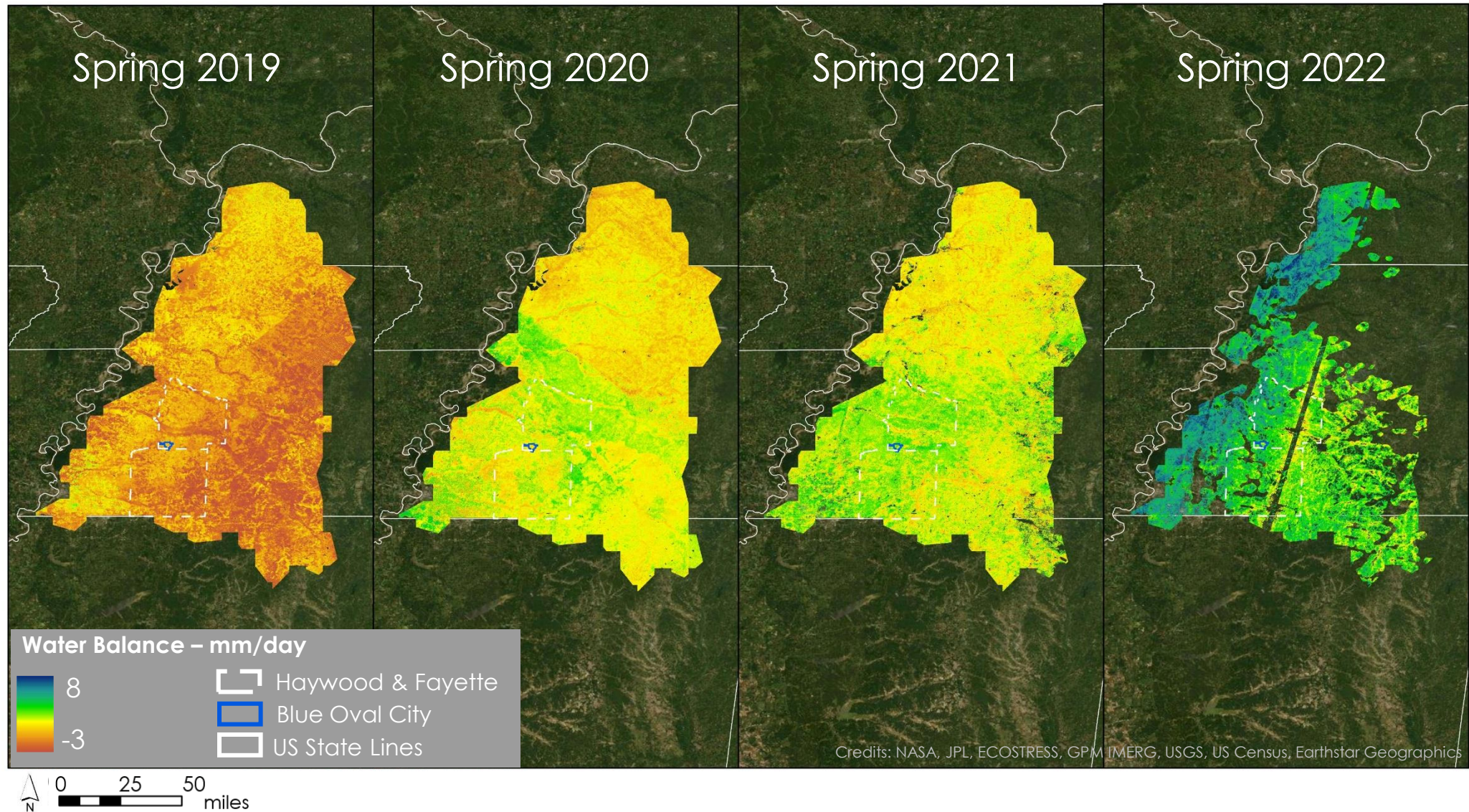
# Data Processing – Water Balance

PRECIPITATION — EVAPOTRANSPIRATION = WATER BALANCE



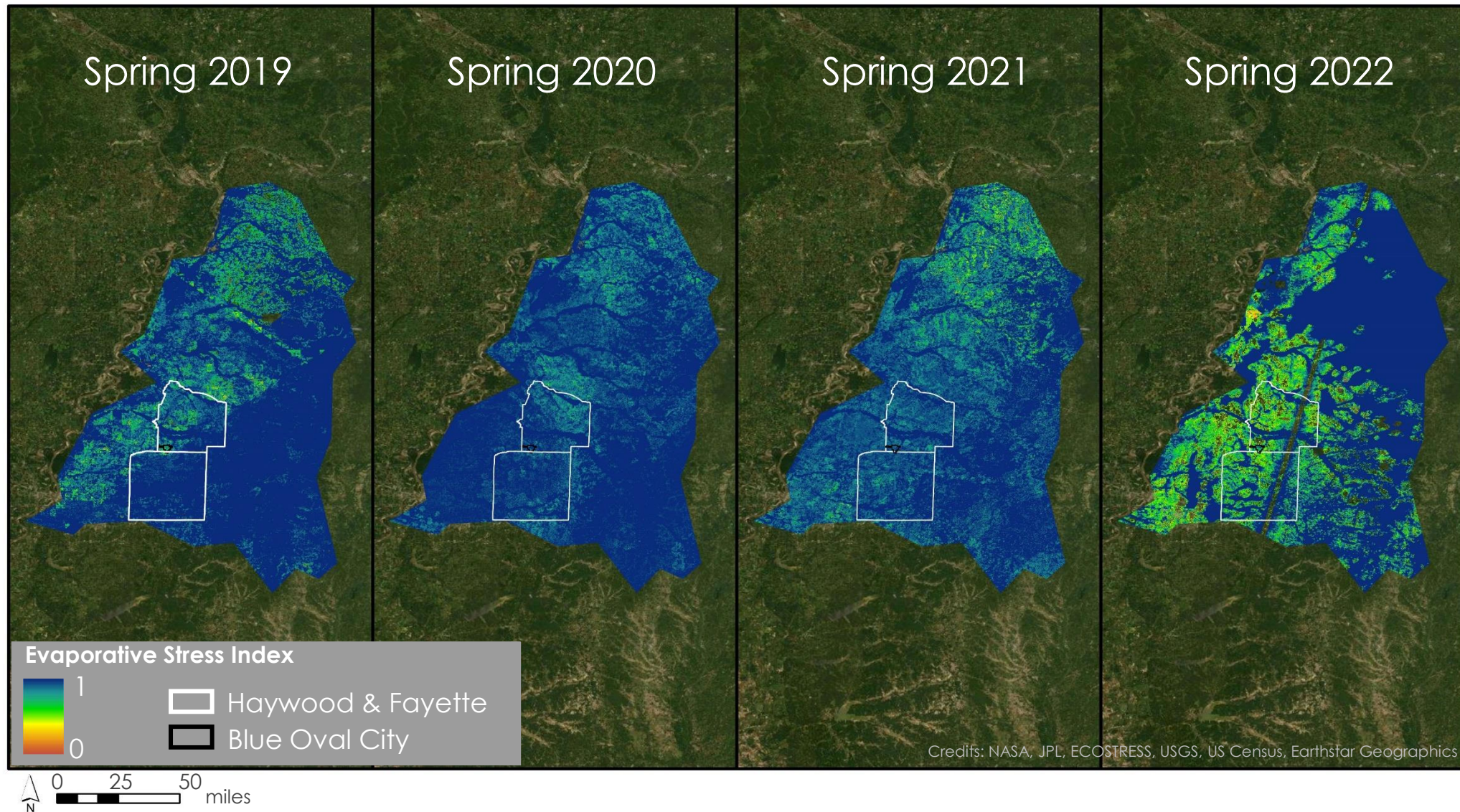


# Spring Seasonal Water Balance



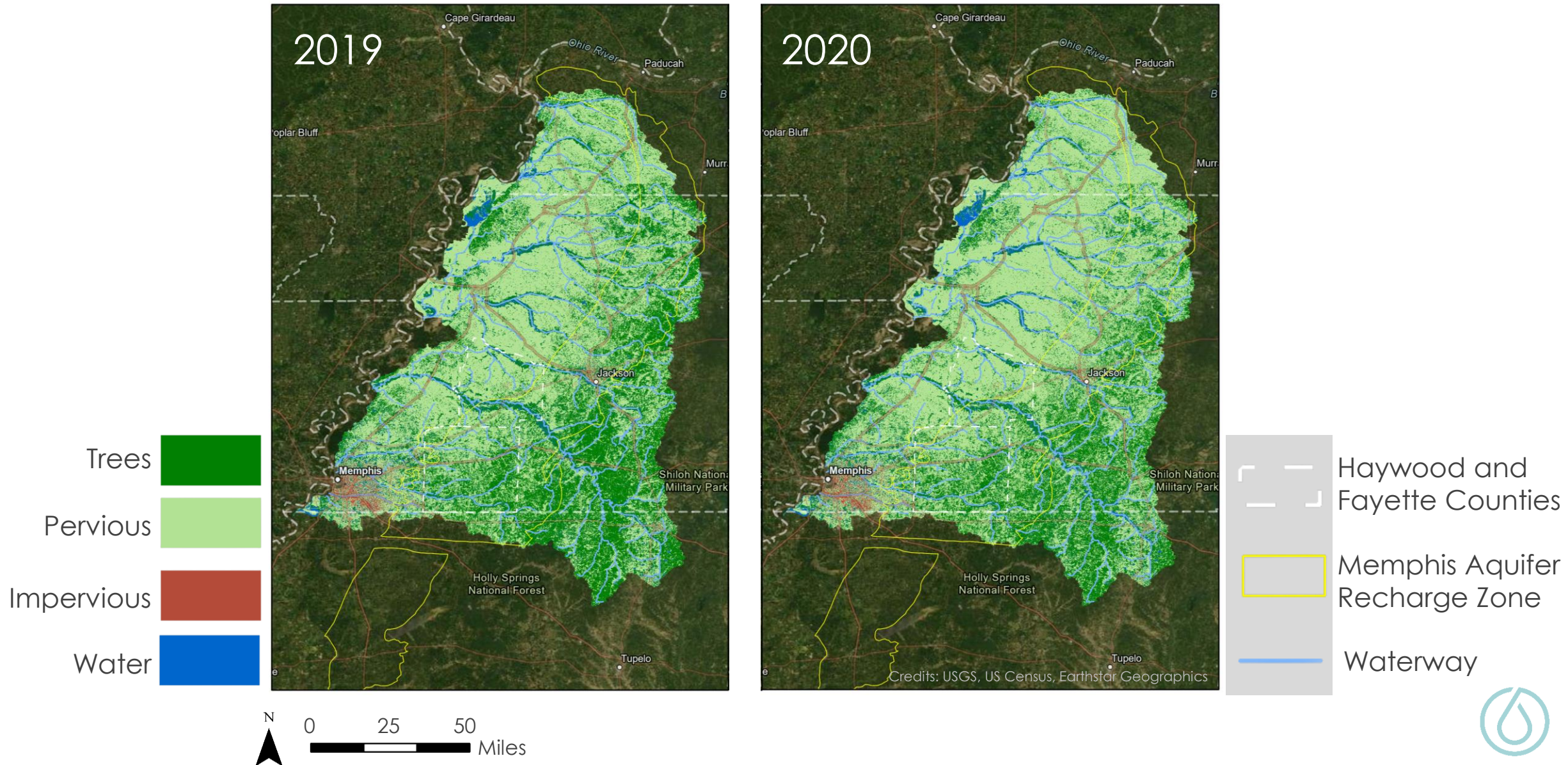


# Spring Seasonal Evaporative Stress Index



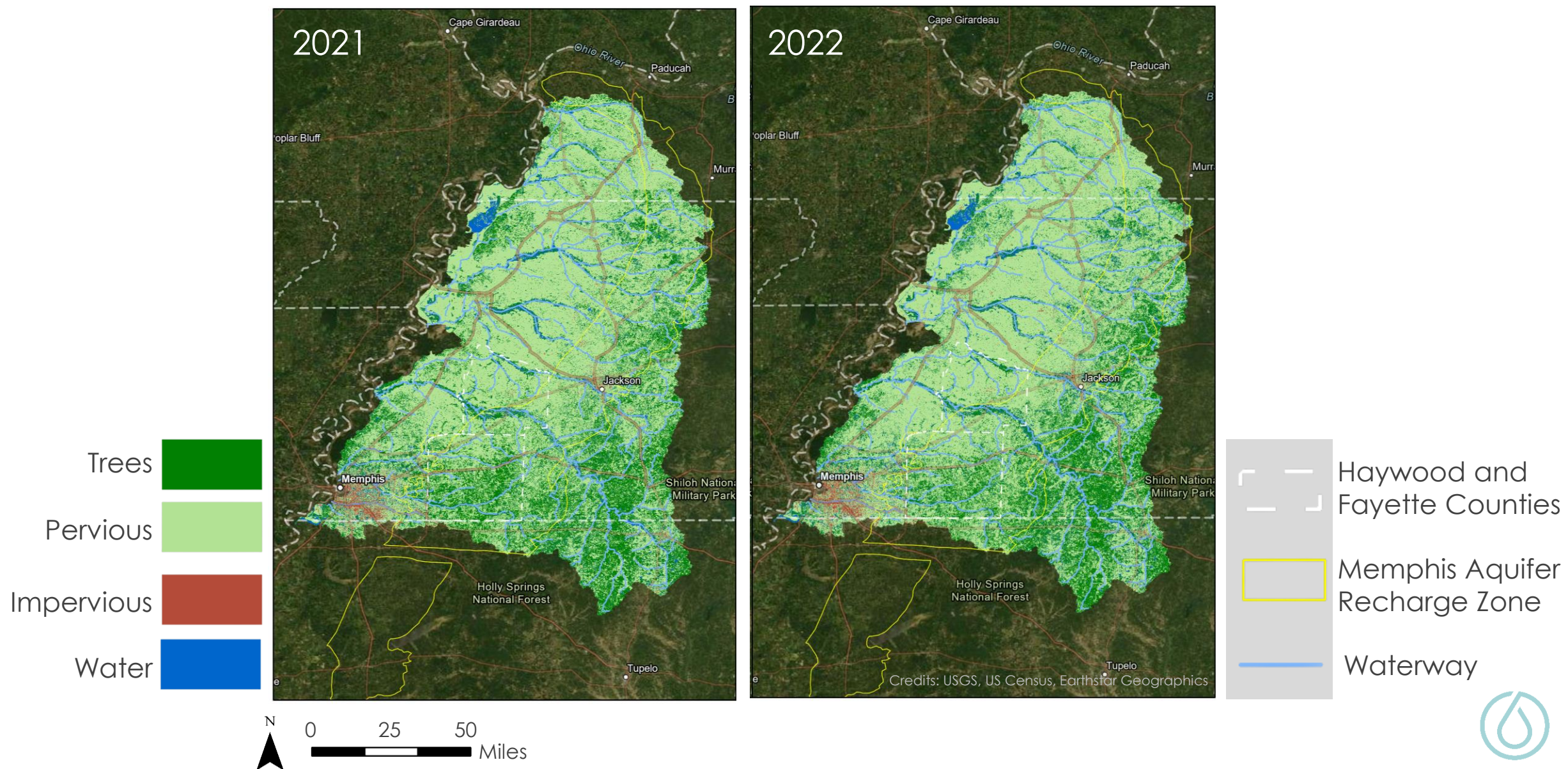


# Landcover Maps for 2019 & 2020





# Landcover Maps for 2021 & 2022

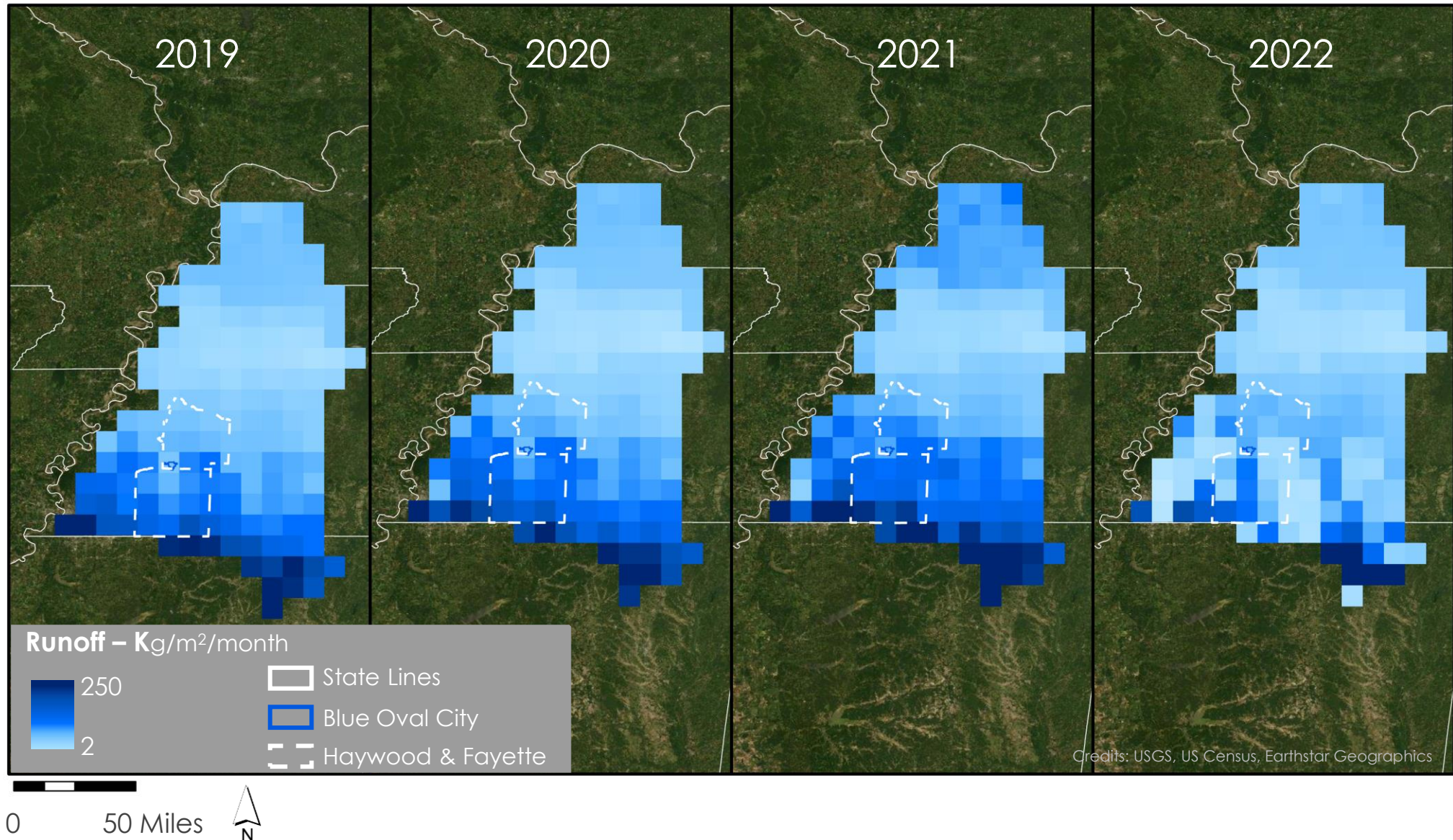


|            | 2019 Land Cover<br>(km <sup>2</sup> ) | 2022 Land Cover<br>(km <sup>2</sup> ) | Percent Change  |
|------------|---------------------------------------|---------------------------------------|-----------------|
| Trees      | 87,173.73                             | 58,915.34                             | 32.42% decrease |
| Pervious   | 50,712.04                             | 40,328.94                             | 20.47% decrease |
| Impervious | 685.47                                | 656.98                                | 4.16% decrease  |
| Water      | 38.42                                 | 41.73                                 | 8.62% increase  |



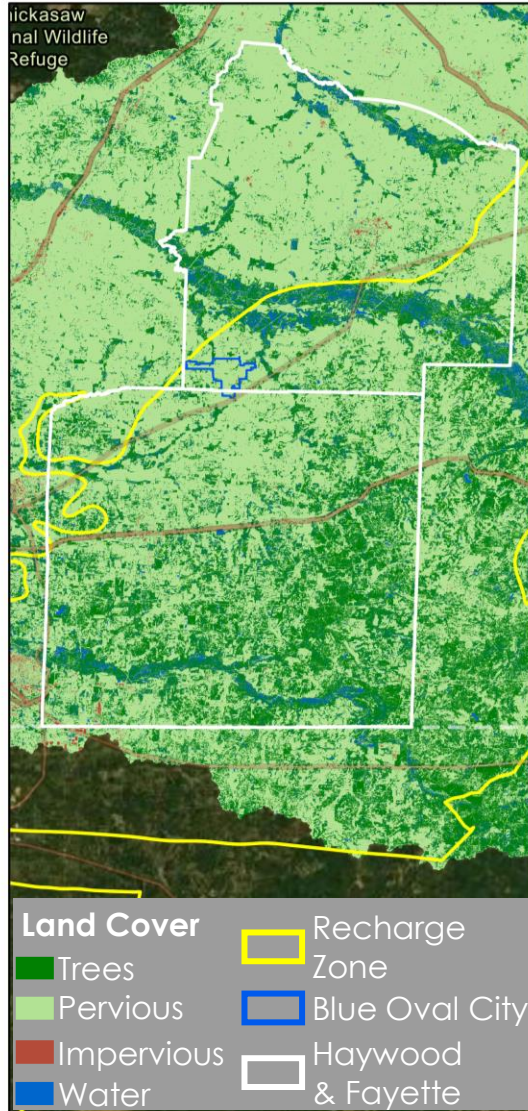


# Spring Runoff 2019 – 2022

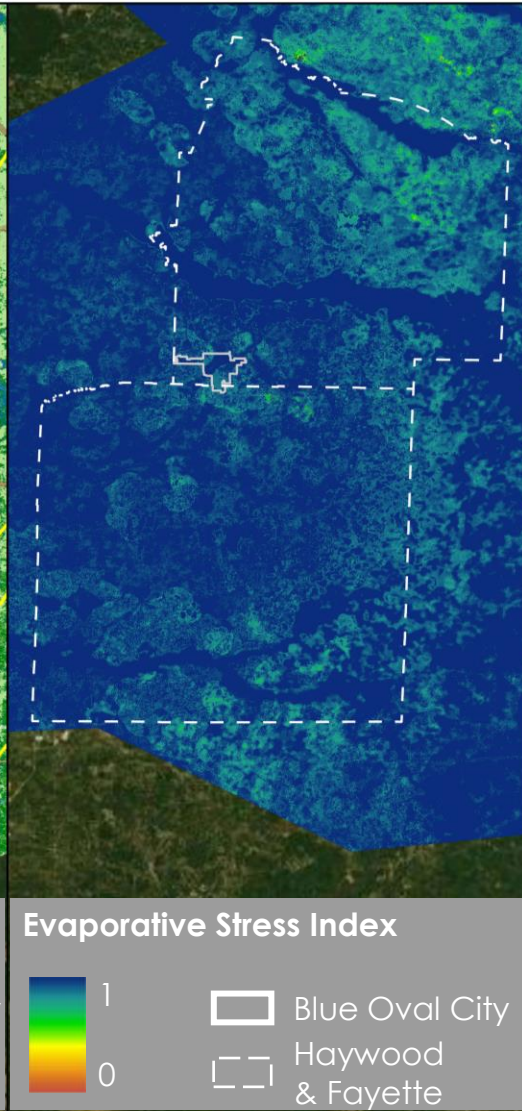




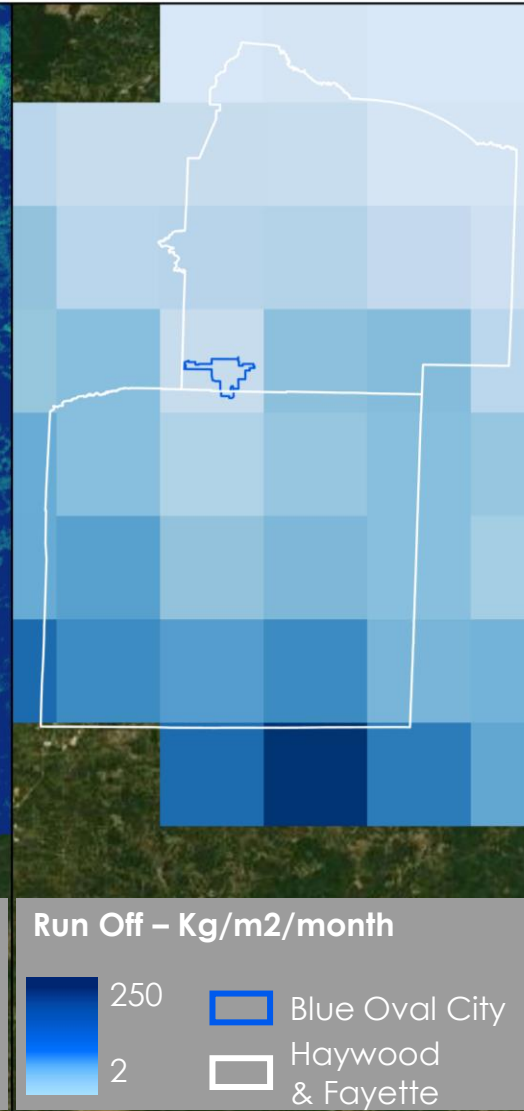
# Land Cover 2020



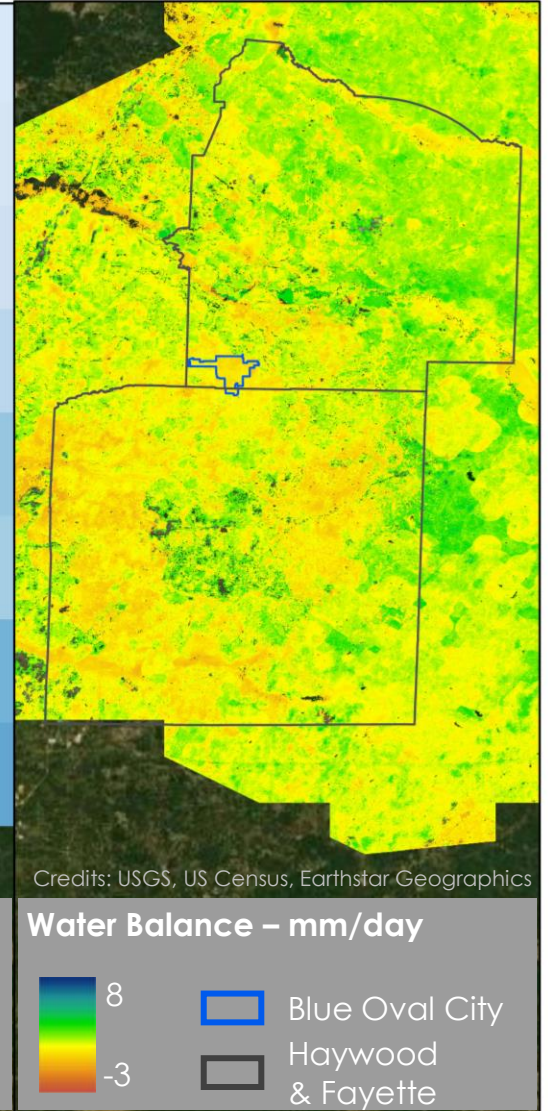
# Evaporative Stress Index Spring 2020



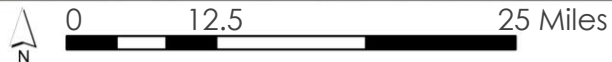
# Run Off Spring 2020



# Water Balance Spring 2020



Credits: USGS, US Census, Earthstar Geographics



# Errors and Uncertainties



Data gaps in  
ECOSTRESS



GPM IMERG Final Run  
vs Late Run



# Future Work



**Validate** water balance and thriving index results with final run GPM-IMERG



**Explore** other factors that influence groundwater recharge



**Create** a tool for real-time groundwater monitoring



**Evaluate** changes to ground subsidence





# Acknowledgements

## Partners

- **Protect Our Aquifer**
  - Sarah Houston (Executive Director)
  - Ward Archer (President)
  - Jim Kovarik (Board Member)
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  - Brian Waldron (Director)
  - Scott Schoefernacker (Associate Director)
- **Tennessee Department of Environment and Conservation**
  - Brian Ham (Environmental Consultant)

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- Brenna Hatch
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- Claire Villanueva-Weeks

## NASA DEVELOP

- Kathleen Lange (NASA DEVELOP JPL Fellow)

## Science Advisors

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- Benjamin Holt (NASA Jet Propulsion Laboratory, California Institute of Technology)